



University of Hawaii at Manoa

Hawaii Natural Energy Institute

Holmes Hall 246 • 2540 Dole Street • Honolulu, Hawaii 96822

May 28, 1991

RECEIVED

91 MAY 30 P 3: 18

DIV. OF WATER &
LAND DEVELOPMENT

Mr. Norman Hayashi
Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Hayashi:

As required in the County of Hawaii Planning Commission's geothermal resources permit (GRP 89-1), five (5) copies of the April, 1991 monthly report are enclosed.

If you have any questions, please call me at 522-5620.

Sincerely,

Harry Olson
Principal Investigator

Enclosure: April monthly report

APRIL 1991 MONTHLY REPORT

Scientific Observation Hole (SOH) Program

Geothermal Resource Permit: GRP 89-1

Lilewa, Kapoho, and Halekamahina, Hawaii

TMK: 1-2-10:01; 1-4-01:02; and 1-4-02:32

Hawaii Natural Energy Institute

University of Hawaii

May 1991

SUMMARY

Drilling continued at SOH-2 from 2,966 feet to a depth of 5,102 feet (2,136 feet) for this reporting period. Minor caving problems were encountered in several isolated intervals. Due to the instability of the hole below 4,070 feet, a mixed casing string of 5 inch, 4-1/2 inch and CHD 134 drill rods were run to 4,103 feet and the hole was drilled with HQWL from 4,108-4,212 feet. Core drilling then progressed from 4,212-4,682 feet in very competent submarine volcanics, intrusives and clastic sediments. From there, core drilling advanced from 4,682-4,988 feet in excellent drilling conditions except for a 57 foot faulted/sheared interval from 4,883-4,940 feet. The faulted interval resulted in short core runs, dropped core and some redrilling. Bottom hole temperatures increased rapidly from approximately 4,000 feet with a maximum temperature of 348°F recorded at 4,902 feet. Due to the continued problems from the deviation in the hole at approximately 1,880 feet, the hole was reduced to NQ (2.98 inch hole X 1.875 inch core). The NQ core rods are much lighter, more flexible and have a much smaller diameter. Core drilling then progressed to a depth of 5,102 feet with full returns of drilling fluids, 10 foot core runs and 100 percent recovery. Bottom hole temperatures measured 400°F at 5,051 and 5,102 feet.

The sump material at SOH-1 is being analyzed to determine if it is suitable for disposal at the County landfill or if it should be buried on site. SOH-3 remains in the permitting stage awaiting a grading and grubbing permit.

I. INTRODUCTION

This document presents a monthly report to the County of Hawaii Planning Department to support the Scientific Observation Hole (SOH) program in the Kilauea Middle and Lower East Rift Zones. The SOHs are for scientific observation purposes only. The information to be gained from the SOHs will provide an assessment of subsurface geological conditions, groundwater level and composition, temperature, drilling conditions, an inventory of possible mineral and geothermal resources, and an eruptive history of the island to the depth drilled.

This report addresses: occurrence and duration of any start-up, shut-down, and operation mode of any SOH/facility; performance testing, evaluation, calibration checks, and adjustment and maintenance of the continuous emission monitor(s) that have been installed; and emission measurements.

II. BACKGROUND

The County of Hawaii Planning Commission approved, on August 8, 1989, a geothermal resource permit application (GRP 89-1) to drill Scientific Observation Holes (SOHs) in the Kilauea Middle and Lower East Rift Zone. This document presents a monthly report, as required in Condition 6:

"The petitioner shall maintain a record in a permanent form suitable for inspection and five (5) copies shall be filed with the Planning Department on a monthly basis during drilling and for six (6) months after the completion of drilling to establish a hole specific baseline and such record shall be available to the community. The record shall include:

- a. Occurrence and duration of any start-up, shut-down, and operation mode of any SOH/facility.
- b. Performance testing, evaluation, calibration checks, and adjustment and maintenance of the continuous emission monitor(s) that have been installed.
- c. Emission measurements reported in units compatible with applicable standards/guidelines."

As designated, four holes are planned to be drilled along the Kilauea East Rift Zone on the Big Island of Hawaii. Three of the Big Island holes (SOHs 1, 2, and 4) are on agriculture land and have been permitted by the County of Hawaii Planning Commission. The fourth hole, designated SOH-3, is on

conservation land. SOH activities under Conservation District Use Permit (HA 12/20/85 - 1830) issued to the Estate of James Campbell have been approved.

III. SOH-1 SITE

Drilling Activity

Drilling is complete. The sump material is being analyzed to determine if it is suitable for disposal at the County landfill or if it should be buried on site. The site will be reclaimed to its original state after testing and monitoring are completed.

Monitoring Program -

Air Quality, Meteorological, Noise and Emissions are not monitored, as drilling has been completed at this site.

IV. SOH-2 SITE

Tonto Drilling Services continued drilling activities from 2,966 to a depth of 5,102 feet (2,136 feet) for this reporting period. Minor caving problems were encountered in several isolated intervals between the 2,966-3,770 foot interval. Bottom hole temperatures increased to 100°F below 3,632 feet. The 5-7/8 inch hole was advanced from 3,770-4,103 feet with minor caving and sticking problems. On April 9, 1991, the 134mm drill rods separated at 1,878 feet, but were fished out on the first attempt. Due to the instability of the hole below 4,070 feet, a

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research.

2. The second part of the report is a detailed description of the methodology used in the study. It includes information about the sample, the data collection methods, and the statistical analysis.

3. The third part of the report is a presentation of the results of the study. It includes a summary of the findings and a discussion of their implications.

4. The fourth part of the report is a conclusion and a list of references. The conclusion summarizes the main findings of the study and provides recommendations for future research.

5. The fifth part of the report is an appendix containing additional information related to the study, such as raw data, questionnaires, and interview transcripts.

6. The sixth part of the report is a bibliography listing the sources used in the study.

7. The seventh part of the report is a list of figures and tables included in the study.

8. The eighth part of the report is a list of abbreviations and acronyms used in the study.

9. The ninth part of the report is a list of acknowledgments.

mixed casing string of 5 inch, 4-1/2 inch and CHD 134 drill rods were run to 4,103 feet and the hole was drilled with HQWL from 4,108-4,212 feet. Core drilling progressed from 4,212-4,682 feet in very competent submarine volcanics, intrusives and clastic sediments. The "dog leg" (sudden change in hole deviation) in the 1,860-1,890 foot interval continues to be a source of problems. The drill string weight increases as the hole becomes deeper and periods of high torque caused by temperature and formation conditions stresses the drilling rods as they are rotated past this dog leg. Core drilling advanced from 4,682-4,988 feet. Drilling conditions were excellent except for a 57 foot faulted/sheared interval from 4,883-4,940 feet. The faulted interval resulted in short core runs, dropped core and some redrilling. Bottom hole temperatures increased rapidly with a maximum temperature of 348°F recorded at 4,902 feet. Since the deviation in the hole at approximately 1,880 feet continued to hinder progress, the hole was reduced to NQ (2.98 inch hole X 1.875 inch core). The NQ core rods are much lighter, more flexible and have a much smaller diameter. Core drilling progressed to a depth of 5,102 feet with full returns of drilling fluids, 10 foot core runs and 100 percent recovery. Bottom hole temperatures measured 400°F at 5,051 and 5,102 feet.

Monitoring Program - Air Quality

The air quality monitoring station provides a continuous record of atmospheric H₂S concentrations when interfaced with a

data logger or chart recorder. The unit is located in a utility container on-site and power is provided by the drill rig system.

This station required minor adjustment and the replacement of some components during this report period. On April 12, 1991, a chart jammed occurred resulting in the loss of some data. Repairs and calibrations were made and for the rest of the month the monitor operated normally (see appendix for details).

Monitoring Program - Meteorological

Continuous wind speed and directional measurements are being made with a recording wind speed/direction sensor system. A data logger and back-up pressure-sensitive recorder is being used to record the wind speed and direction data. The unit is located in a utility container on-site and power is provided by the drill rig system.

This station operated normally through the month with minor adjustment and calibration. A chart jam occurred on April 17, 1991, resulting in the loss of some data (see appendix for details).

Monitoring Program - Noise

One noise monitoring station is located at the SOH-2 site during drilling and is operated by power provided by the drill rig system. This station operated normally through the month

with minor adjustment and calibration. On April 29, 1991, a chart jam occurred resulting in the loss of data. The jam was cleared and the chart transport recorder reworked (see appendix for details).

A second noise station is located at the Perry residence, about a third of a mile north of the SOH-2 drill site. The instrument at this station is powered by solar charged batteries and operated normally for the month with minor adjustments and calibrations. Chart jams, which are indicative of this type of monitoring equipment, continue to be a problem (see appendix for details).

A third noise monitoring station is located at the Hedtke residence, about 0.4 of a mile east of the SOH-2 site. This monitor is powered by solar charged batteries. On April 3, 1991, the solar panel shorted a connector. Repairs were made and the monitor tested. On April 17, 1991, the chart and meter batteries were replaced and on April 19, the main battery was replaced (see appendix for details).

Emissions Reports

An H₂S monitor is located on-site. The average H₂S level measured is about 1 ppb due to natural causes resulting from the decay of vegetation. Colortek sensor canisters are located around the perimeter of the SOH-2 drill site and are replaced

weekly as a matter of routine. The sensors showed no indication of any emissions from the well.

V. SOH-3 SITE

No drilling activity has been initiated. Access to the SOH-3 site has not been constructed, nor has the site been cleared or graded. SOH-3 is scheduled to be located at the True/Mid-Pacific alternate drill site 2 (approximately 3,000 feet north-north-west of the present drill site). All necessary reports have been submitted to DLNR for review and approval. An expanded archaeology survey on the Buffer Zone surrounding the proposed SOH-3 site has been completed and submitted to DLNR. The field work for a topographic survey was carried out on April 25, 1991, in preparation for the grading plan for the proposed SOH-3 site.

VI. SOH-4 SITE

Drilling Activity

Drilling is completed. No activity was performed during this period. The Landowner, Campbell Estate, has seeded the site with experimental Mamaki, Kopiko, and Ohia seeds collected from plants in the nearby area.

Monitoring Program -

Air Quality, Meteorological, Noise and Emissions are not monitored, as drilling has been completed at this site.

APPENDIX
MAINTENANCE REPORTS

SUPPLEMENTARY BILLING

		HOURS	PARTS
J-093	<p>Wednesday, 4-3-91</p> <p>SOH-2 H2S Operating normally. Made minor adjustment.</p> <p>SOH-2 MET Operating normally. Chart O.K.</p> <p>SOH-2 SOUND Operating normally. Chart and Pen O.K.</p> <p>PERRY SOUND Inoperative...Chart jammed - Lost 35 hours data. Repaired jam, tested. O.K.</p> <p>HEDTKE SOUND Inoperative...Solar panel shorted at connector. Lost 45 hours data. Repaired connector, tested. O.K.</p>	2.00	
J-095	<p>Friday, 4-5-91</p> <p>SOH-2 H2S Operating normally. Ran full calibration. No adjustments were necessary. Renewed chart.</p> <p>SOH-2 MET Operating normally. Full calibration. No adjustments were necessary. Renewed chart.</p> <p>SOH-2 SOUND Operating normally. Renewed chart. Full calibration. Minor adjustments to both sound meter and recorder.</p> <p>PERRY SOUND Operating normally. Renewed chart. Full calibration. Minor adjustments to both sound meter and recorder.</p> <p>HEDTKE SOUND Operating normally. Renewed chart. Full calibration. Minor adjustment to sound meter.</p> <p>COLORTEK Replaced colortek cards. No visible color change.</p>	3.00	
J-098	<p>Monday 4-8-91</p> <p>SOH-2 H2S Operating normally. No adjustments necessary.</p> <p>SOH-2 MET Operating normally.</p> <p>SOH-2 SOUND Chart ran out. Lost some data. Replaced chart.</p> <p>PERRY SOUND Operating normally at station check, but previous chart jam caused some data loss.</p> <p>HEDTKE SOUND Operating normally. Replaced pen, no other adjustments.</p>	2.00	
J-100	<p>Wednesday, 4-10-91</p> <p>SOH-2 H2S Operating normally. No adjustments necessary.</p> <p>SOH-2 MET Operating normally. No adjustments necessary.</p> <p>SOH-2 SOUND</p>	2.00	

Bad chart jam caused loss of 36 hours data. Repaired jam and checked operation. O.K.

PERRY SOUND

Operating normally. Only battery service required.

HEDTKE SOUND

Operating normally. No adjustments required.

J-102 Friday, 4-12-91 3.00

SOH-2 H2S

Chart jammed. Lost 48 hours data. Repaired chart recorder. Full zero and span calibration. No corrections were required.

SOH-2 MET

Operating normally. Calibration check O.K. Renewed chart and adjusted recorder.

SOH-2 SOUND

Operating normally. Full calibration but no need for adjustments to recorder or sound meter.

PERRY SOUND

Operating normally. Full calibration. Minor adjustment made to meter and recorder.

HEDTKE SOUND

Operating normally. Full calibration. No corrections were required for meter or recorder. Serviced batteries.

COLORTEK

Replaced colortek cards. No visible color change.

J-105 Monday, 4-15-91 2.00

SOH-2 H2S

Operating normally. Replaced lead acetate tape.

SOH-2 MET

Operating normally. Replaced chart.

SOH-2 SOUND

Operating normally. Chart, pen and batteries O.K.

PERRY SOUND

Pen ran dry. Lost a few hours data. Replaced pen and serviced batteries.

HEDTKE SOUND

Operating normally. Chart, pen and batteries O.K.

J-107 Wednesday, 4-17-91 2.00

SOH-2 H2S

Operating normally. No adjustments necessary

SOH-2 MET

Chart jammed. Lost several hours data.

SOH-2 SOUND

Operating normally. Adjusted chart recorder... it was recording 3 db too high.

PERRY SOUND

Operating normally. Replaced chart.

HEDTKE SOUND

Operating normally. Replaced chart and meter batteries.

J-109 Friday, 4-19-91 3.00

SOH-2 H2S

Operating normally. Renewed chart, minor maintainance, full calibration. No adjustments were required.

SOH-2 MET

Operating normally. Renewed chart, checked calibration.

SOH-2 SOUND

Operating normally. Minor adjustments were made to both sound meter and recorder during recalibration.

PERRY SOUND

Operating normally. Full calibration... Slight adjustment to sound meter, none to recorder.

HEDTKE SOUND

Lost about 20 hours data to chart jam. Full calibration was performed. No adjustments necessary to either sound meter or recorder. Replaced main battery.

J-112 Monday, 4-22-91 2.00

SOH-2 H2S

Operating normally. Adjusted zero calibration.

SOH-2 MET.

Operating normally. Adjusted chart recorder.

SOH-2 SOUND

Operating normally. Replaced battery.

PERRY SOUND

Chart jammed. Lost about 30 hours data. Replaced spare batteries.

HEDTKE SOUND

Chart jammed. Lost about 55 hours data.

J-114 Wednesday, 4-24-91 2.00

SOH-2 H2S

Operating normally. Adjusted zero calibration.

SOH-2 MET

Operating normally. Chart O.K.

SOH-2 SOUND

Operating normally. Replaced battery.

PERRY SOUND

Operating normally, but previous chart jams caused lost of about 18 hours data.

HEDTKE SOUND

Operating normally. Chart, pen and batteries O.K.

J-116 Friday, 4-26-91 3.00

SOH-2 H2S

Operating normally. Full calibration-minor adjustment. Renewed chart. Replaced Lead Acetate.

SOH-2 MET

Operating normally. Calibration check O.K. Renewed chart and checked chart recorder.

SOH-2 SOUND

Operating normally. Replaced chart and pen. Ran full calibration. No meter adjustment. 3db chart recorder adjustment was necessary.

PERRY SOUND

Chart had jammed twice for a loss of 29 hours data. Full calibration- No corrections were required for either recorder or meter. Chart, pen and batteries O.K.

HEDTKE SOUND

Operating normally. Renewed chart. Replaced batteries. Full calibration - Minor recorder adjustment, no correction required for sound meter.

COLORTEK

Replaced colortek cards. No color change.

J-119 Monday, 4-29-91 2.00

SOH-2 H2S

Operating normally. No adjustments necessary.
SOH-2 MET
Operating normally. Chart O.K.
SOH-2 SOUND
Bad chart jam. Lost 70 hours data. Cleared jam
and reworked recorder chart transport.
PERRY SOUND
Operating normally. Replaced pen. Chart & Batts. O.K.
HEDTKE SOUND
Operating normally. Replaced batteries.

J-121 Wednesday, 5-1-9 2.00
SOH-2 H2S
Operating normally. Renewed chart.
SOH-2 MET
Operating normally. Renewed chart.
SOH-2 SOUND
Operating normally. Renewed chart. Replaced Batt.
PERRY SOUND
Operating normally. Renewed chart. Batt. O.K.
HEDTKE SOUND
Pen ran dry, Lost 19 hours data. Replaced pen and
batteries. Renewed chart.

SOH-2 Met Station
4-1-91 to 4-30-91

Time	W/D	W/S	W/D	W/S	W/D	W/S	W/D	W/S
	0401		0402		0403		0404	
0000	325	3	20	3	60	5	45	7
0001	360	2	10	2	45	5	45	4
0002	360	3	10	2	50	4	35	4
0003	215	3	30	3	45	3	30	4
0004	45	4	30	2	55	2	40	4
0005	45	4	270	3	50	3	25	3
0006	55	5	280	3	265	4	40	4
0007	65	6	310	3	270	4	20	3
0008	60	8	320	3	270	3	290	3
0009	50	10	30	4	270	3	40	8
0010	50	11	35	6	310	3	40	9
0011	40	8	40	7	50	7	45	9
0012	35	9	30	6	60	11	35	8
0013	40	9	15	5	65	10	40	4
0014	40	11	5	5	50	11	35	8
0015	30	10	45	7	35	7	40	9
0016	35	10	55	7	40	7	30	9
0017	30	8	60	8	35	6	30	8
0018	25	7	60	11	45	6	15	5
0019	30	5	40	4	40	4	30	6
0020	25	5	35	3	35	3	40	8
0021	25	4	50	6	35	3	45	6
0022	15	3	60	6	35	4	10	2
0023	20	3	60	7	40	6	60	8
	0405		0406		0407		0408	
0000	70	9	35	7	40	5	265	4
0001	70	10	45	8	40	5	260	3
0002	70	10	70	13	45	5	260	3
0003	60	6	40	4	40	4	105	4
0004	60	7	295	3	45	6	90	2
0005	55	6	50	2	45	5	250	2
0006	65	7	275	3	50	7	185	2
0007	55	5	290	3	35	4	305	2
0008	70	11	35	5	50	6	50	2
0009	60	10	40	8	70	9	100	4
0010	65	10	95	8	75	8	100	6
0011	45	9	45	10	85	10	120	7
0012	40	9	45	11	90	12	95	9
0013	40	9	45	11	75	10	120	9
0014	45	11	40	12	50	10	115	9
0015	45	12	35	8	70	8	110	9
0016	40	10	25	8	75	8	120	11
0017	40	9	30	8	75	8	180	7
0018	45	12	40	11	70	8	195	2
0019	45	10	35	5	70	8	225	2
0020	45	8	30	6	50	5	255	2
0021	40	7	35	7	25	4	255	2
0022	45	8	40	5	300	3	220	2
0023	55	12	30	4	280	3	230	2

	0409		0410		0411		0412	
0000	220	2	130	5	75	2	50	2
0001	125	2	125	4	75	2	50	2
0002	125	2	95	4	75	2	50	2
0003	155	2	105	4	75	2	45	3
0004	165	2	110	5	85	3	55	4
0005	130	2	115	5	95	6	55	3
0006	130	2	125	4	95	5	150	3
0007	125	2	125	4	100	5	250	3
0008	105	5	115	5	90	8	310	4
0009	135	4	115	5	85	8	70	8
0010	130	5	110	9	85	9	65	8
0011	135	8	85	8	85	9	75	8
0012	130	8	120	9	80	9	85	8
0013	125	9	110	10	65	8	90	8
0014	120	11	90	9	55	7	90	10
0015	130	8	90	8	40	7	90	9
0016	125	7	90	9	50	8	90	8
0017	110	6	90	7	60	10	70	7
0018	115	5	95	6	65	8	55	5
0019	105	6	110	5	60	7	60	4
0020	110	6	95	4	60	6	55	4
0021	120	5	125	5	60	6	55	4
0022	120	5	135	4	50	4	65	4
0023	130	5	200	2	50	2	65	5

	0413		0414		0415		0416	
0000	60	4	260	2	185	3	-	-
0001	50	5	260	2	240	3	-	-
0002	80	4	260	2	150	3	-	-
0003	75	4	260	2	145	2	-	-
0004	45	3	260	2	165	2	-	-
0005	35	2	175	2	225	2	-	-
0006	255	3	185	2	270	3	-	-
0007	270	3	180	2	280	3	-	-
0008	280	3	145	3	310	3	-	-
0009	290	3	135	2	25	6	-	-
0010	310	3	110	5	40	7	-	-
0011	10	4	85	5	40	8	-	-
0012	30	5	90	5	45	10	-	-
0013	40	5	85	7	50	9	-	-
0014	45	5	85	7	40	9	-	-
0015	35	5	55	7	35	9	-	-
0016	50	5	55	6	-	-	-	-
0017	35	3	65	4	-	-	-	-
0018	25	2	55	3	-	-	-	-
0019	15	2	60	3	-	-	-	-
0020	15	2	60	2	-	-	-	-
0021	295	2	60	2	-	-	-	-
0022	260	2	60	2	-	-	-	-
0023	260	2	170	3	-	-	-	-

	0417		0418		0419		0420	
0000	-	-	40	2	45	2	255	3
0001	-	-	80	7	45	2	255	2
0002	-	-	85	8	75	8	255	2
0003	-	-	95	8	80	9	255	3
0004	-	-	50	8	80	9	260	3
0005	-	-	40	7	90	9	260	4
0006	-	-	45	5	90	9	270	5
0007	-	-	45	3	90	9	310	4
0008	-	-	50	5	90	9	340	4
0009	75	11	55	7	85	10	360	5
0010	80	10	65	8	60	9	15	6
0011	80	10	60	7	75	10	40	7
0012	85	9	55	6	70	9	40	8
0013	70	8	55	5	65	8	40	7
0014	35	6	45	4	60	9	45	8
0015	45	7	45	3	50	8	55	8
0016	40	8	40	3	45	8	40	7
0017	60	9	45	4	35	4	35	5
0018	70	9	45	3	40	3	40	3
0019	55	7	45	2	45	2	40	3
0020	45	4	45	2	45	2	40	3
0021	45	3	45	2	45	2	40	3
0022	45	2	45	2	160	3	40	3
0023	40	2	45	2	255	4	15	2

	0421		0422		0423		0424	
0000	270	3	55	2	45	3	60	5
0001	270	3	55	2	345	2	85	8
0002	270	3	55	2	270	3	55	3
0003	270	2	55	2	270	3	15	2
0004	270	3	55	2	270	3	80	4
0005	270	3	245	3	270	3	85	4
0006	270	3	260	3	270	3	90	2
0007	270	3	260	3	270	3	80	8
0008	305	4	295	3	295	3	65	7
0009	310	5	350	4	315	4	90	9
0010	35	5	45	6	10	3	90	14
0011	35	5	70	11	45	3	80	13
0012	35	6	80	11	40	5	90	14
0013	45	7	75	10	360	4	95	13
0014	35	7	65	9	55	9	90	12
0015	50	8	45	9	70	10	90	12
0016	50	9	45	8	70	10	90	10
0017	60	9	45	8	65	11	75	8
0018	55	8	40	7	65	9	65	7
0019	50	5	45	6	65	9	55	5
0020	55	6	45	6	60	8	55	5
0021	55	3	40	5	65	7	60	5
0022	55	2	35	4	65	7	55	4
0023	55	2	30	3	60	6	50	3

	0425		0426		0427		0428	
0000	50	2	100	6	65	6	45	4
0001	50	3	95	7	65	5	50	4
0002	50	2	90	7	70	4	50	5
0003	50	2	95	5	80	2	50	7
0004	65	3	90	4	80	2	50	4
0005	90	9	90	3	80	2	45	2
0006	95	2	90	2	80	3	45	2
0007	210	3	90	2	250	3	45	2
0008	270	3	85	4	255	3	340	2
0009	50	4	90	5	255	3	265	3
0010	60	6	95	7	255	3	275	3
0011	90	10	85	9	285	5	60	6
0012	90	11	85	9	95	7	95	7
0013	90	11	90	10	95	8	50	4
0014	90	10	90	11	80	8	15	4
0015	105	10	90	11	90	11	50	3
0016	100	9	90	9	100	11	360	4
0017	95	8	80	8	70	10	25	4
0018	90	7	85	8	80	11	50	3
0019	85	5	95	6	55	10	25	4
0020	90	5	75	8	60	9	80	7
0021	90	6	80	5	55	7	60	5
0022	90	7	65	8	55	4	55	6
0023	100	7	70	8	50	3	60	6

	0429		0430	
0000	65	4	60	6
0001	60	5	60	7
0002	85	4	55	6
0003	80	3	55	7
0004	80	3	55	8
0005	80	3	55	2
0006	80	2	55	2
0007	80	2	55	2
0008	80	2	145	3
0009	40	4	300	4
0010	20	6	360	4
0011	25	7	25	5
0012	30	7	30	6
0013	40	8	45	8
0014	45	9	45	8
0015	45	10	40	7
0016	40	9	65	7
0017	35	7	80	9
0018	40	6	70	7
0019	40	5	65	7
0020	50	8	60	8
0021	45	5	55	7
0022	80	8	60	6
0023	55	3	45	5

H2S CHART REDUCTION -- SOH-2 Station

4-1-91 to 4-30-91

HOUR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Avg	Max	Total
0401	0	1	0	1	0	1	0	1	1	1	1	3	2	1	2	1	2	2	1	1	1	1	1	0	1	3	25
0402	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1	2	1	1	1	1	1	0	1	1	1	2	16
0403	0	1	1	1	1	0	0	0	1	1	1	1	2	2	2	2	1	2	1	1	2	1	1	1	1	2	26
0404	1	1	1	1	1	1	0	1	1	1	2	2	2	2	2	1	2	2	2	2	1	0	1	1	1	2	31
0405	1	1	1	1	0	0	1	1	1	2	1	1	2	2	2	2	3	2	2	1	1	1	1	0	1	3	30
0406	1	0	1	0	1	1	1	1	1	1	2	2	2	2	3	3	3	3	2	2	1	2	1	1	2	3	37
0407	1	1	1	1	0	1	1	1	1	1	1	2	2	2	2	2	3	2	2	1	1	2	1	1	1	3	33
0408	1	1	1	1	1	1	1	1	2	2	1	1	2	2	1	1	1	1	1	1	1	1	2	2	1	2	30
0409	2	1	1	0	1	0	0	0	1	1	1	0	2	2	2	1	1	1	0	1	0	0	0	0	1	2	18
0410	0	0	0	0	0	1	0	0	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	1	1
0411	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0	0
0412	*	*	*	*	*	*	*	*	*	2	1	1	1	2	2	2	2	2	1	2	1	1	1	1	1	2	22
0413	0	1	1	1	0	1	1	0	1	1	0	1	1	2	2	2	1	2	1	0	1	1	0	1	1	2	22
0414	1	1	0	1	2	1	1	1	0	1	1	1	1	2	2	1	1	1	2	2	2	1	2	1	1	2	29
0415	1	1	0	1	0	0	1	1	1	2	2	3	3	3	3	2	3	3	2	1	1	1	1	0	2	3	36
0416	0	0	0	0	1	1	1	2	1	0	1	2	2	3	3	3	2	2	2	2	1	1	1	0	1	3	31
0417	0	1	1	0	0	1	1	1	1	1	1	2	1	1	2	1	2	2	*	*	*	2	1	1	1	2	23
0418	1	*	*	*	*	2	1	*	*	*	*	*	*	*	*	*	*	2	2	1	2	1	1	1	1	2	14
0419	1	1	1	1	1	2	1	1	1	1	1	1	2	2	1	3	2	1	1	1	1	1	0	0	1	3	28
0420	0	1	0	1	1	1	1	1	2	2	2	2	2	1	2	2	2	2	2	1	1	1	1	1	1	2	32
0421	2	2	1	1	2	1	1	1	1	2	1	1	1	3	3	2	2	2	2	2	1	1	1	1	2	3	37
0422	0	0	1	1	1	1	2	2	2	3	2	2	2	3	3	3	2	2	2	2	2	2	1	2	2	3	43
0423	2	2	1	2	2	2	1	2	1	2	2	2	2	2	2	2	2	3	2	1	2	2	1	1	2	3	43
0424	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	2	1	1	1	1	2	22
0425	1	1	0	0	1	1	0	1	1	1	1	1	1	1	2	2	1	2	1	1	1	2	2	2	1	2	27
0426	2	2	1	1	0	2	2	2	2	2	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	2	28
0427	1	1	0	0	0	0	0	1	1	1	1	*	*	1	1	1	1	1	0	0	1	1	2	2	1	2	17
0428	1	1	1	0	0	0	1	1	0	*	*	*	1	1	2	2	2	2	1	1	2	1	1	1	1	2	22
0429	1	1	1	1	1	1	1	1	2	2	1	2	1	1	2	2	1	1	1	1	1	1	2	1	1	2	30
0430	1	2	2	2	1	2	1	1	2	2	2	1	1	2	1	1	0	1	0	1	1	2	2	2	1	2	33

786

AVG.	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	2	1	1	1	1	1	1	1	1	
MAX.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	

** = power or equipment failure; * = calibration

All measurements in points per billion (ppb)

J-093 Wednesday 4-3-91

SOH-2 H2S

Range 0-2

Flow steady @ 3.0, chart + lead acetate OK

Drained Tygon - Filled Bobbin - Cleaned sample chamber.

Check 32.870, up .470

Optics steady @ 2370-2370

Range - High 1:1 Low 1:1 - Adj for 1:1

Zero Calib 30 8 2 2 (Zero Pot Tweak Right) 0

SOH-2 MET

Operating Normally - Chart OK

SOH-2 Sound 0910 Clouds 95% WS + Dir 350 @ 2

Operating Normally - Chart + Pen OK

Ready Sound 0950 Clouds 100% - Calm

Inoperative - Chart Jammed - Lost 35 Hooks. Replaced jam.

Main Batt 1237 - Meter Batt 1181-1206 - Removed spares

For Exchange

Heater Sound 0820 Clouds 100% - Rain Calm

Inoperative - Found solar panel shorted (corrosion) at connection.

Replaced connection - Tested - O.K. Lost 45 Hooks - Main Batt 1206

Meter Batt 1234 - (MET) - Replaced with spares - 1233

J-095 Friday 4-5-91

SOH-2 H2S

Range 0-2 uph

Flow steady @ 3.0, Renewed Chart - Replaced Lead Acetate

Tygon Dry - Pump + Bobbin O.K.

Check 32.770, down .170

Optics 2370-2400, up 10 m, adj to 2400-2400

Range - High 1:1 Low 1:1

Zero Calib 31 5 2 1 0

Span Calib - Exp 50 50 50 50 } No Adj.

Act 36 48 49 50

SOH-2 MET

Operating Normally - Renewed Chart - Calib Check O.K.

SOH-2 Sound 0855 Clouds 35% WS + Dir 70° @ 12-15

Operating Normally - Chart + Pen O.K. - Replaced Back-up Batt

Full Calib - Adj Meter to 110.0 From 109.9 - Adj Recorder up 10 ft

Ready Sound 0825 Chart 60% WS + Dir 120° @ 5-6

Operating Normally - Chart + Pen O.K. - Main Batt 1271

Meter Batt 116.5-1199 - Replaced with spares - 1259-1200

Full Calib Adj Meter to 110.0 From 109.8 - Adj Recorder down 10 ft

(OVER)

(4-5-91 Can't)

Hedke Sound 0805 Clouds 60% W/S + DIR 30° @ 2-3

Operating Normally - Chart + Pen O.K. Main Batt 12.36

Meter Batt 1158-1197 Replaced with Spares 1242-1247

Full Calibration - Adj Meter to 110.0 from 110.2 - Adj Recorder - No.

Colonte R

Replaced Colonte R Cans - No Visible Color Change

J-098 Monday 4-8-91

SOH-2 H₂S

Range 0-2 pph

Flow Steady @ 3.0, Chart + Lead Acetate O.K.

Drained Tygon - Pump + Bubbler O.K.

Check 32.6%, down .1%

Optics 2400-2390, down 10 →, adj to 2390-2590

Range High 1:1 Low 1:1

Zero Calib 30 ± 3.0

SOH-2 Met

Operating Normally - Chart O.K.

SOH-2 Sound 0855 Clouds 95% Calm

Chart Pen out - some data lost - Replaced Chart

Penon Sound 0837 Clouds 90% Calm

Operating Normally - Previous Chart Jam caused a little data loss.

Main Batt 12.65, Meter Batt 1215-1226 - Spares 1238-1237

Hedke Sound 0820 Clouds 100% Calm

Operating Normally - Replaced Pen - Main Batt 11.92, Replaced with 12.49 - Meter Batt 1213-1195 - Spares 1202-1237.

J-100 Wednesday 4-10-91

SOH-2 H₂S

Range 0-2 pph

Flow Steady @ 3.0, Chart + Lead Acetate O.K.

Tygon Dry - Pump + Bubbler O.K.

Check 32.9%, up .3%

Optics Steady @ 2410-2410

Range - High 1:1 Low 1:1

Zero Calib 30 ± 3.0

SOH-2 Met

Operating Normally - Chart O.K.

SOH-2 Sound 0835 Clouds 100% W/S + DIR 125° @ 4-5

Bad Chart Jam caused 36 HOUR data loss -

Repaired Jam - Replaced Spare Batt

J-100 (cont)

Penny Sound 0818 Clouds 100% Calm

Operating Normally - Main Batt 12.29, Meter Batt 1196-1211

Spares 1231-1192 - Removed for Recharge

Hedike Sound 0805 Clouds 100% - WS + DIR 115 @ 3-4

Operating Normally - Main Batt 12.09 - Meter Batt 1197-1173

Spares 1228-1227

J-102 Friday 4-12-91

SOH-2 Res

No Data

Chart Jammed - No Data for 48 Hours

Flow steady @ 3.0, Chart Replaced - Lead Acetate OK

Tygon Dry - Pump + Bubble OK

Check 33.0%, up .1%

Optics steady @ 2400-2400

Range - High 1.1 Low 1.1

Zero Calib 32 13 1.0

Span Calib - Exp 50 50 50 50 50

Act 19 41 43 49 50

SOH-2 Met

Operating Normally - Checked Calibration - Replaced Chart

SOH-2 Sound Clouds 80% (0902) WS + DIR 50° @ 4-5

Operating Normally - Chart + Pen OK - Full Calibration -

No Meter or Recorder Adjustment Required - Batt OK

Penny Sound 0825 Clouds 70% WS + DIR 45° @ 6-7

Operating Normally - Chart + Pen OK - Main Batt 12.68

Meter Batt 1192-1210 - Spares 1234-1234 - Full Calib.

Adj Meter to 110.0 from 109.7, Adj Recorder down 1/2 dt.

Hedike Sound 0807 Clouds 75% WS + DIR 360 @ 3-4

Operating Normally - Chart + Pen OK - Main Batt 12.14

Meter Batt 1186-1156, Replaced with spares 1241-1233

Full Calibration - No adjustments required for Meter or Recorder

Colortek

Replaced Colortek Cards - No visible Color Change.

J-105 Monday 4-15-91

SDH-2 H2S

Range ϕ -2

Flow steady @ 3.0, chart OK - Replaced lead Acetate

Tygon Dry - Pump + Bubbles OK

Check 32.4% down .6%

Optics steady @ 2390-2390

Range - High 1:1 Low 1:1

Zero Calib 31 6 2 0

SDH-2 Met

Operating Normally - Replaced Chart.

SDH-2 Sound 0854 Clouds 40%, WS + DIR 10° @ 4-5

Operating Normally - Chart + Pen OK

PENN Sound 0825 Clouds 60%, WS + DIR 360° @ 2-3

Pen Run Dry - Lost some Data - Replaced Pen, Main

Batt 12.48 - Meter Batt 11.62 - 11.17, Replaced with 1232-1223

Hed the Sound 0810 Clouds 60% WS + DIR 315° @ 2-3

Operating Normally - Chart + Pen OK - Main Batt 11.93

Meter Batt 1189-1209 - Spares 1252-1237

J-107 Wednesday 4-17-91

SDH-2 H2S

Range ϕ -2 ppb

Flow steady @ 3.0, chart + lead Acetate OK

Tygon Dry - Pump + Bubbles OK

Check 21.1% down .3%

Optics steady @ 2390-2390

Range - High 1:1 Low 1:1

Zero Calib 30 4 4 0 0

SDH-2 Met

Chart Jammed - last several hours - Reset Chart Brake.

SDH-2 Sound 0900, Clouds 95%, WS + DIR 75° @ 6-8

Operating Normally but Chart Recorder Jolt High - Adjusted.

Cleaned Battery Connectors + Replaced Battery

PENN Sound 0835 Clouds 100%, WS + DIR 360° @ 2-3

Operating Normally - Replaced Chart - Main Batt 12.18

Meter Batt 1204-1199 - spares 1249-1254

Hed the Sound 0815 Clouds 100%, Rain - Calm

Operating Normally - Replaced Chart - Main Batt 11.44

Meter Batt 1143-1204 - Replaced with spares 1255-1238

J-109 Friday 4-19-91

SOH-2 H25

Range 0-2 ppb

Flow steady @ 3.0 - Renewed Chart - Lead Acetate O.K.

Drainage Tygon - Filled Bubbler - Cleaned Sample Chamber.

Check 32.6%, up .5%

Optics 2390-2380 - down 10 m, No Adj.

Range High 1.1 Low 1.1

Zero Calib 32.7 1.0

Span Calib - Exp 50 50 50 50

Act 38 48 49 50

SOH-2 Met

Operating Normally - Renewed Chart Calibration Check O.K.

SOH-2 Sound 0905 Clouds 15% WS + DIR 60° @ 4-5

Operating Normally - Renewed Chart - Full Calibration -

Adj Meter to 110.0 from 109.8 - Adj Recorder up 2 cft.

Perry Sound 0825 Clouds 10% WS + DIR 80° @ 4-5

Operating Normally - Main Batt 12.53 - Meter Batt 1197-1191

Spares 1253-1257 - Full Calib. - Adj Meter to 110.0 from 110.4

No Recorder Adj. Necessary.

HedThe Sound 0805 Clouds 25% - WS + DIR 20° @ 2-3

Lost about 30 hours to Chart Jam. Main Batt 1183 - Replaced

with 1261 - Meter Batt 1241-1227 - Spares 1263-1252

Full Calib. - No Adj. Necessary for Meter or Recorder

Collected

Replaced Colored Cards - No Visible Color Change

J-112 Monday 4-23-91

SOH-2 H25

Range 0-3 ppb

Flow steady @ 3.0, Chart + Lead Acetate O.K.

Tygon Dry - Pump + Bubbler O.K.

Check 32.0%, down .6%

Optics 2390-2400, up 10 m, adj to 2400-2400

Range - High 1.1 Low 1.06 High, adj for 1.1

Zero Calib 30 14 2 1 (3-45 Pet) 0

SOH-2 Met

Operating Normally - Adjusted Chart Recorder

SOH-2 Sound 0905 Clouds 90% WS + DIR 25° @ 2-3

Operating Normally - Chart + Pen O.K. - Replaced Battery.

Perry Sound 0845 Clouds 80% WS + DIR 30° @ 2-3

Chart Jammed - Lost about 30 hours - Main Batt 1173

Meter Batt 1177-1161, Replaced with Spares 1252-1257

(4-22-91 Cont)

Hed The Sound Clouds 80% Calm

Chart Jammed - Lost about 55 hours - Main Batt 1242

Meter Batt 1220-1212, Spares 1256-1249

J-114 Wednesday 4-24-91

SON-2 HASRange ϕ - 2 ppb

Flow steady @ 3.0, chart + head acetate OK

Tygon Dry - Pump + Bubbles OK

Check steady @ 32.0%

Optics steady @ 2340-2340

Zero Calib. 31 18 2 1 (Zero Pot Tired Klett)

SON-2 Met

Operating Normally - Chart OK

SON-2 Sound 0845 Clouds 95% WS + DIR 60° @ 5-6

Operating Normally - Chart OK - Replaced Batt.

Perry Sound 0820 Clouds 95% WS + DIR 20° @ 2-3

Operating Normally - Previous Chart Jam caused 18 hour data loss.

Main Batt 1252 - Meter Batt 1223-1224 - Spares 1232-1153

Hed The Sound 0807 Clouds 95% WS + DIR 15° @ 2-3

Operating Normally - Main Batt 1230 - Meter Batt 1196-1193

Spares 1241-1239 - Chart + Pen OK

F116 Friday 4-26-91

SON-2 HASRange ϕ - 2

Flow steady @ 3.0 - Replaced Chart - Replaced head Acetate

Tygon Dry - Bubbles OK - Cleared Sample Chart

Check 32.7%

Optics 2430-2440, up 10 μ , adj to 2440-2440

Zero Calib 31 5 2 0 0

Span Calib 29 41 49 51 (Adj span Pot Klett) 50

SON-2 Met

Operating Normally - Replaced Chart - Check Normal

SON-2 Sound 0934 Clouds 60% WS + DIR 90° @ 5-6

Operating Normally - Replaced Chart + Pen - Full Calibration

Meter OK @ 110.0 - Chart Recorder was 3rd Low - Adjusted.

Perry Sound 0850 Clouds 50% WS + DIR 60° @ 5-6

Chart Jammed Twice - Lost 29 hours - Full Calibration -

Meter OK @ 110.0 - Recorder OK - Main Batt 1261 - Meter

Battery 1227-1223 - Spares 1243-1250

Hed The Sound 0830 Clouds 50% WS + DIR 15° @ 2-3

Operating Normally - Full Calib - Meter OK @ 110.0 - Recorder was

1/2 1st Low - Adj - Main Batt 1218 - Meter Batt 1181-1187

J-119 Monday, 4-29-91

SOH-2 HRS

Range ϕ - 2 ppb

Flow Steady @ 3.0, Chart + Lead Acetate O.K.

Tygon Dry - Pump + Bubbles O.K.

Check 32.4%, down .3%

Optic's 2410-2390, down 20-4, adj. to 2400-2400

Range - High 1:1 Low 1:1

Zero Calib 28 8 1 0 0

SOH-2 Met

Operating Normally - Chart O.K.

SOH-2 Sound 0835 Clouds 90% WST DIR 340 @ 3-4

Bad Chart Jam - Lost 70 Hours Data - cleared Jam and

checked Recorder Chart Transport - All O.K.

Penny Sound 0815 clouds 95% Calm

Operating Normally - Replaced Pen - Chart O.K.

Main Batt 1228 - Meter Batt 1200-1189 - Spares 1226-1224

Hedthe Sound 0800 clouds 95% Calm

Operating Normally - Main Batt 1177, Replaced with 1214

Meter Batt 1193-1217 - Spares 1261-1244

J-12 Wednesday, 5-1-91

SOH-2 HRS

Range ϕ - 2 ppb

Flow Steady @ 3.0, Renewed Chart - Lead Acetate O.K.

Tygon Dry - Pump + Bubbles O.K.

Check 31.7%, down .7%

Optic's Steady @ 2420-2420

Range - High 1:1 Low 1:1

Zero Calib 30 6 10 0

SOH-2 Met

Operating Normally - Renewed Chart

SOH-2 Sound 0858 Clouds 70% - Calm

Operating Normally - Renewed Chart - Replaced Batt

Penny Sound 0835 clouds 75% - Calm

Operating Normally - Renewed Chart - Main Batt 1255

Meter Batt 1193-1177 - Spares 1227-1225

Hedthe Sound 0815 clouds 70% - Calm

Pen Run Dry - Lost 19 Hours - Replaced Pen - Renewed Chart

Main Batt 1195 - Meter Batt 1193-1177 - Replaced with

Spares 1259-1242